Original article

Kardiologia Polska
2010; 68, 4: 381–390

ISSN 0022–9032

Comparative analysis of conservative, percutaneous, and surgical treatment outcomes in patients with significant stenosis of the left main coronary artery during five-year follow-up

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Abstract

Background and aim: Significant left main coronary artery stenosis (LMS) conveys adverse prognosis and until recently its treatment has been restricted to surgical intervention. We evaluated the long term outcome of patients with LMS treated using different approaches i.e. medical treatment, surgical (CABG, coronary artery bypass graft) and percutaneous (PCI, percutaneous coronary intervention).

Methods: We analysed 450 patients with significant LMS (%DS > 50%). Group 1 (G1) included 105 patients who did not qualify for invasive treatment. Group 2 (G2) included 282 patients who underwent CABG. Group 3 (G3) comprised 67 patients who received stent into LMS. We analysed the incidence of invasive treatment complications in G2 and G3 and the overall incidence of adverse cardiac events that comprised death, repeated myocardial infarction, and the necessity of repeated revascularisation during hospital stay and long term follow-up.

Results: During the 5-year follow-up, the highest mortality was noted in the G1 in comparison to G2 and G3 (31.3% *vs* 24.5% *vs* 26.8% respectively). There was no difference in mortality between G2 and G3. The incidence of myocardial infarction was the lowest in G3 (22.2%) followed by G1 (40.8%) and G2 (45.1%). No difference was detected in the occurrence of repeated PCI in LMS (G2 — 19.85%, G3 — 13.4%) and CABG (G1 — 12.2%, G2 — 10.2%, G3 — 9.0%). The incidence of target vessel revascularisation was the highest in G1, followed by G2 and G3 (69.49% *vs* 53.19% *vs* 31.35% respectively).

Conclusions: Our study showed that CABG and PCI provide similar long-term outcome in patients with LMS.

Key words: stenosis of the left main stem, percutaneous coronary intervention, coronary artery bypass graft

Kardiol Pol 2010; 68, 4: 381–390

INTRODUCTION

In about 7–10% of patients with angina undergoing coronary angiography, significant stenosis of the left main stem (LMS) is found [1]. All studies concerning LMS disease equivocally point to adverse prognosis in stenosis of this specific segment of the coronary tree, in terms of survival as well as recurrent coronary events [1, 2]. Long-term studies have demonstrated that 50% of the patients die within 5 years from the diagnosis [1]. Therefore, demonstrating angiographically significant stenosis of the left main (i.e. at least 50% narrowing of the lumen) represents an indication for revascularisation. Nevertheless, the treatment choice — percutaneous coronary intervention (PCI) *vs* surgical approach (CABG, coronary artery by-pass grafting) — is still vividly discussed.

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Received: 14.09.2009 **Accepted:** 02.12.2009

The aim of the study was to compare outcome of patients with significant LMS stenosis in relation to the treatment option, i.e. medical, surgical (CABG) or PCI with bare metal stent implantation.

METHODS

Study group

Patients in whom coronary angiography was performed between 01.01.2000 and 31.12.2005 were retrospectively analysed. In 450 (6.88%) of these patients, significant LMS stenosis (at least 50% diameter reduction) was diagnosed. The study population was then divided into 3 groups depending on the treatment received.

Group 1 (G1) consisted of 105 medically treated patients (23.3%) i.e. the patients who were not eligible for CABG according to cardiac surgeon's opinion due to high risk, lack of peripheral coronary segments suitable for grafting and advanced atherosclerosis, or patients who declined the interventional/surgical treatment (n = 48; 47.5%).

Group 2 (G2) consisted of 282 (62.6%) patients who underwent CABG. Within this group, in 225 (79.8%) patients left interior mammary artery (LIMA) was anastomosed to left anterior descending (LAD). Complete revascularisation was achieved in 217 (76.9%) of these patients. It should be noted that in 22 (7.8%) of G2 patients CABG was performed in the setting of a non ST-elevation acute coronary syndrome (NSTE-ACS), and in the remaining G2 patients elective CABG was performed (57.4 ± 14.8 days).

Group 3 (G3) consisted of 67 (14.8%) patients in whom PCI of unprotected LMS was performed. In 70.15% of patients, the intervention was carried out in the setting of ACS (58.2% STEMI, 11.95% NSTEMI). The rest of G3 (29.85%) were patients with stable angina in whom PCI was carried out because of excessive surgical risk which made them not eligible for CABG (EUROSCORE ≥ 6) [3].

Clinical characteristics of the study population are presented in Table 1.

PCI

Patients with ACS undergoing PCI received 5000 IU of unfractionated heparin (UFH) i.v., 300 mg of acetylsalicylic acid (ASA), and 300 or 600 mg (according to the current ESC guidelines) of clopidogrel. In case of elective LMS interventions, patients received 75 mg of clopidogrel and 75 mg ASA daily.

In 18 (26.9%) patients, intracoronary ultrasound was carried out before and after stent implantation in LMS. In the remaining 49 (73.1%) patients, stent size was selected on the basis of quantitative coronary angiography (QCA) measurements. Abciximab (ReoPro, Centrocor, Eli Lilly) was applied in 20% of PCI patients. All patients who underwent PCI of

Table 1. Clinical characteristics of the study population

	Group 1: conservative treatment	Group 2: CABG	Group 3: PCI
n	105	282	67
Male (%)	80	83	70
Age (years)	70.01 ± 9.49*	66.52 ± 10.47*	67.70 ± 10.44
EF first (%)	41.68 ± 10.67*	49.06 ± 10.19* ^	41.58 ± 12.85 ^
EF last — during long term follow-up (%)	33.5 ± 9.52*#	41.02 ± 10.08* ^	45.68 ± 8.06# ^
Acute coronary syndrome (%)	51.4	47.7 ^	70.15 ^
Cardiogenic shock (%)	0.95#	0.35 ^	29.85 ^ #
Hypertension (%)	72.4	77.03	71.2
Diabetes (%)	35.2	26.5	31.8
Insulin-dependent diabetes (%)	20.0*	7.4* ^	18.2 ^
Prior infarction (%)	53.3	47.7	43.9
Chronic kidney disease (%)	17.1	7.7	25.8
Significant peripheral atherosclerosis (%)	45.7	39.2	41.5
Smoking (%)	60.0	39.2	41.5
Dyslipidemia (%)	67.6	63.1	71.2
Prior PCI (%)	7.7	10.3	7.6
Angiographic type of CAD:			
1-vessel (%)	21.9	14.9	25.4
2-vessel (%)	22.8	38.65	29.85
3-vessel (%)	49.5	44.3	26.9

*G1 *vs* G2 $p < 0.001$ for age $p < 0.005$, #G1 *vs* G3 $p < 0.005$, ^ G2 *vs* G3 $p < 0.00005$; EF — ejection fraction; PCI — percutaneous coronary intervention; CABG — coronary artery by-pass grafting

the LMS were subject to extended cardiovascular follow-up, including 6 week exercise testing and coronary angiography at 3 to 6 months after PCI.

Medical therapy

Long term pharmacotherapy was not significantly different in the three study groups and included ASA, clopidogrel, statins, beta-blockers, ACE inhibitors and diuretics.

Long-term follow-up

Major adverse cardiovascular event (MACE) rate was evaluated perioperatively, at 30 days, at one year and long-term (i.e. at 2–5 years). Primary end-points included cardiovascular death, ACS, target lesion revascularisation (TLR) in the LMS. Secondary end-points included revascularisation of other coronary arteries (PCI or CABG).

Definitions

- Periprocedural period — time between the beginning of revascularisation procedure (PCI or CABG) and the end of the 12-hour postoperative period.
- Periprocedural mortality — death occurring between the beginning of the revascularisation procedure (PCI or CABG) and the end of 12-hour postoperative period.
- In-hospital mortality — in-hospital death occurring during the hospitalisation for the revascularisation procedure (G2 and G3) or during the hospitalisation in which the diagnosis of LMS stenosis was made (G1).
- Significant LMS stenosis — ≥ 50% narrowing of the lumen in relation to the reference segment.
- Unprotected LMS — no vascular graft connecting aorta with left coronary artery.
- Angiographic success — PCI resulting in residual stenosis of the revascularised vessel not exceeding 20% and TIMI 3 flow.
- Periprocedural success — good angiographic PCI result without hemodynamic deterioration and other complications (death in the cathlab, cardiovascular event, myocardial infarction (MI) within 12 hours from the procedure).
- Post-revascularisation MI — new Q-wave on ECG recorded post-procedurally or cardiac markers elevation (CK-MB, CPK) at least 3 times above upper limit of normal (ULN) value (PCI) or 5 times above ULN value (CABG).
- MI during follow-up — new Q-wave in the ECG recording post-procedurally or cardiac markers elevation (CK-MB and/or troponin) at least 3 times above ULN value.
- Restenosis (ISR, in-stent restenosis) — ≥ 50% diameter reduction within the stent and within 5-mm segments proximally and distally.

Statistical analysis

Continuous variables are presented as mean values ± standard deviations. Relations between other variables were studied by multiple regression analyses. Borderline significance level was set at $p = 0.05$. Normal distribution was verified by Shapiro-Wilk test. Comparisons of mean values were carried out as follows:

— for unpaired data of normal distribution and homogeneity of variance, t-Student test and analysis of variance with Tukey test were used. In other cases Mann-Whitney U-test and Kruskall-Wallis test were applied;

— for paired data of normal distribution and homogeneity of variance t-Student test for paired data was used. In all other cases Wilcoxon's rank test was applied.

Relations between categorical variables were analysed by multidivided tables, Pearson's χ^2 test and exact Fisher test. Additionally, Wilcoxon-Gehan test was applied, log rank and Wilcoxon-Peto and Peto tests, for comparisons of survival rates between groups.

The analyses were carried out with statistical package STATISTICA 6,0 PL by StatSoft.

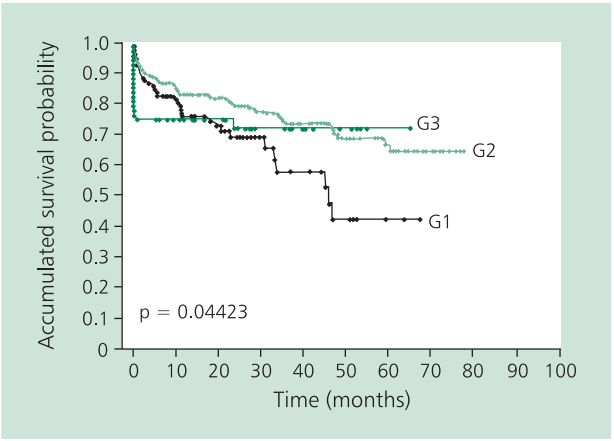

Figure 1. Kaplan-Meier curves presenting survival in the study groups during five-year follow-up (p = 0.044); G1 — medically treated; G2 — CABG; G3 — PCI

RESULTS

Death

During 5-year follow-up, 132 patients died (29.3% of the study population), including 120 cardiovascular deaths (90.9%). During the 5-year observation the highest mortality was noted in the group receiving conservative treatment (31.3%), fewer patients died in the group treated with PCI (26.87%) and the lowest mortality was in the CABG group (24.5%)

The Kaplan-Meyer survival analysis for cardiovascular death demonstrated significant between-group difference (p = 0.044) (Fig. 1).

Early (7-day) mortality rate was significantly higher in G3 compared to G2 (p = 0.03752) as well as in G2 compared to G1 (p = 0.02567). A 30-day follow-up failed to show differences in mortality between G1 and G2. The highest mortality in G3 ($p < 0.05$) resulted chiefly from in-hospital deaths. During the first year of follow-up, no out-of-hospital deaths

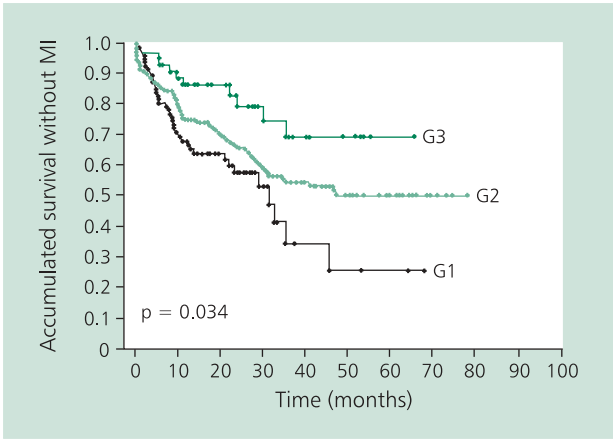

Figure 2. Kaplan-Meier curves presenting myocardial infarction (MI)-free survival in the study groups during five-year follow-up (p = 0.034); abbreviations as in Fig. 1

Table 2. Myocardial infarction rate (%) in the study group by follow-up period

	Group 1: conservative treatment	Group 2: CABG	Group 3: PCI
In-hospital	1.9*	7.8*^	2.9^
30 days	2.8	3.2	0
1 year	24.7^*	15.6^	7.5*
2 year	5.7	7.8	5.9
3 year	5.7	7.8	5.9
4 year	1.9	2.5	0
5 year	0	0.4	0

*p < 0.005, ^p < 0.05

occurred in G3. The highest one-year mortality rate was noted in G1. In G3, after one patient died in the second year, no further deaths were recorded until the end of follow-up. Also in the 4th year of the follow up, mortality was significantly lower in G2 compared to G1 (p = 0.02). In the remaining years, only a trend towards lower mortality in G2 *vs* G1 was noted.

Myocardial infarction

During the entire follow-up period, MI rate was the highest in G2 (45.1%), intermediate in G1 (40.8%) and the lowest in G3 (22.2%). Interestingly, recurrent, MI was noted in 33.5% of the patients.

In the study population, significant difference in infarction-free survival (p = 0.034) was shown between the groups (Fig. 2). In 5 years MI incidence was significantly higher in G1 than in G3 (p = 0.007) as well as in G2 compared with G3 (p = 0.03). No difference was found, however, in MI incidence in G1 *vs* G2.

In-hospital MI in patients with stable angina on admission was significantly more common in G2 than in G1, and more common in G2 than in G3. On the other hand, MI incidence between 30 days and one year was significantly higher in G1 than in G2 and G3. The subsequent years showed a non-significant trend towards a higher rate of MI in G2 compared to the other two groups (Table 2).

Target lesion revascularisation in the left main

During the 5-year follow-up period in 51 (11.3%) patients the need for repeat PCI of LMS was assessed. The intervention was performed in G2 and G3, (more often in G2 than in G3; a non-significant difference), but not in G1 (Fig. 3).

At one year, all PCI procedures in G3 were performed due to restenosis in LMS (11.9%). It is worth mentioning, that during the 2nd year of follow-up PCI of the LMS for *de novo* lesion was performed in only one patient (1.5%).

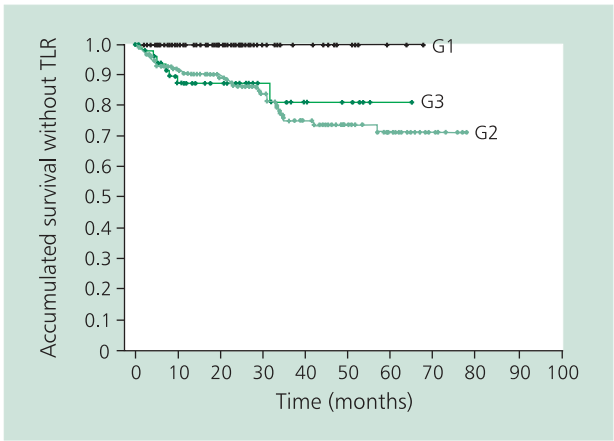

Figure 3. Kaplan-Meier curves presenting percentage of patients in whom target lesion revascularisation (TLR) of LMS was performed during five-year follow-up (p = NS); abbreviations as in Fig. 1

Conversely, in G2, PCI in the first year of observation (9.95%) was necessary because of atherosclerosis progression (greater stenosis diameter in LMS in comparison to baseline, LMS occlusion with impaired inflow to the left circumflex coronary artery, failure of the graft connecting aorta with the LAD). It should be emphasised that in one patient PCI was performed 11 days after CABG due to LMS occlusion and the resulting acute coronary syndrome. The two subsequent PCI procedures within 30 days post-CABG were also performed due to graft occlusion. The remaining PCI procedures in patients with protected LMS (9.9%) were performed in the following years of observation. These procedures were performed more often in the 2nd and 3rd (2.8% and 5.3%, respectively) than in the 4th and 5th (1.1% and 0.7%, respectively) years of follow-up.

Table 3. Reasons for TVR (percutaneous revascularisation in the coronary artery other than LMS)

	Group 1: conservative treatment	Group 2: CABG	Group 3: PCI
Elective PCI (%) at initial coronary angiography	16 (15.29%)	9 (3.19%)	11 (16.4%)
New ACS	33.3%	34.4%	10.4%
Restenosis in the epicardial artery (other than LMS)	5.7%	6.4%	3.0%
Atherosclerosis progression in major coronary arteries	15.2%	9.2%	1.5%

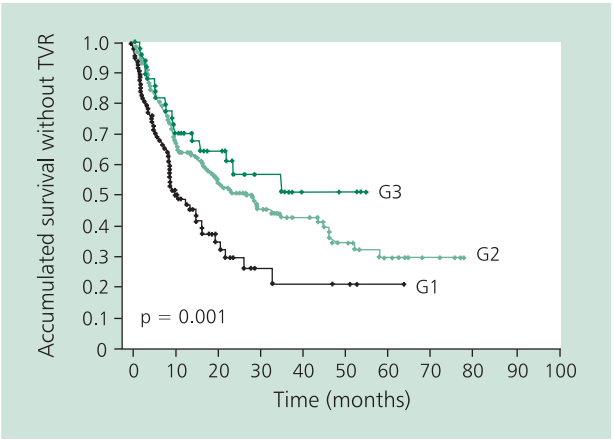

Figure 4. Kaplan-Meier curves presenting the distribution of TVR during 5-year follow-up (G1 *vs* G2 p = 0.0008; G1 *vs* G3 p = 0.006); abbreviations as in Fig. 1

Percutaneous coronary intervention in other vessels

During 5-year follow-up, PCI of a coronary artery other than LMS (target vessel revascularisation — TVR) was warranted in 197 (43.7%) patients. Indications for these procedures are shown in Table 3.

The Kaplan-Meier curve analysis for these procedures revealed a significant difference in the TVR-free survival (p = = 0.001; Fig. 4). During the entire follow-up, TVR was more frequent in G1 than in G2 or G3. Also in the 2nd year of follow-up, TVR was more frequent in G1 than in G2 and more frequent in G1 than in G3. In the remaining years, no differences were found in terms of repeat revascularisation procedures (Table 4).

Table 4. Repeat percutaneous coronary intervention rate (%) in coronary arteries other than LMS in the study group by the follow-up period

	Group 1: conservative treatment	Group 2: CABG	Group 3: PCI
In-hospital	0.9	0.7	0
30 days	3.8	0.7	0
1 year	43.9*^	30.2*	22.4^
2 year	10.5#	12.4&	3#&
3 year	4.7	4.9	4.5
4 year	0.9	4.2	1.5
5 year	0.9	1.06	0

*p < 0.005, ^p < 0.0005, #,& p < 0.05

CABG

The Kaplan-Meier curve analysis for repeat CABG revealed no significant difference in CABG-free survival (Fig. 5). During the entire follow-up, the number of repeat CABG procedures was comparable in the groups (G1 — 12.2%, G2 — 10.2%, G3 — 9.0%).

In 29 (10%) patients in G2 after a MIDCAB procedure (LIMA-LAD anastomosis), repeat CABG was performed with additional graft implanted into LCX or RCA. During initial 30-day treatment period CABG was more frequently performed in G3 than in G2 or G1. In the subsequent 11-month period, CABG was necessary more frequently in G1 than in G2. In G3, however, no CABG procedure was performed during that period. In the subsequent years no significant differences were found in the CABG rate. No CABG procedures were performed during the 5th year of follow-up (Table 5).

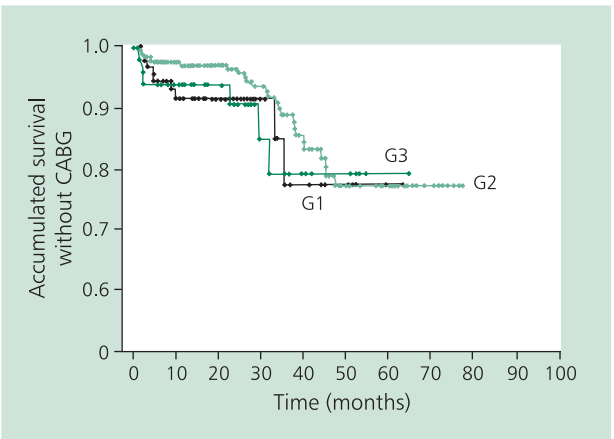

Figure 5. Kaplan-Meier curves presenting percentage of patients in whom CABG was not performed during five-year follow-up (p = NS); abbeviations as in Fig. 1

DISCUSSION

The study population is representative for everyday practice in a 24-hour facility treating patients with ACS. Analysis of

Table 5. CABG rate (%) in the study group by the follow-up period

	Group 1: conservative treatment	Group 2: CABG	Group 3: PCI
In-hospital	0	0	0
30 days	1.9	1.4*	4.5*
1 year	4.7^	1.8^	0
2 year	0	0.4	1.5
3 year	2.8	3.5	3
4 year	2.8	3.1	0
5 year	0	0	0

*$p < 0.05$, ^$p < 0.005$; PCI — percutaneous coronary intervention; CABG — coronary artery by-pass grafting

their characteristics shows a high prevalence of conditions associated with atherosclerosis progression, i.e. diabetes, hypertension, chronic kidney disease, smoking and dyslipidemia. Moreover, nearly 50% of these patients had a history of prior MI with reduced ejection fraction (EF < 50%). This is in accordance with the fact, that LMS disease is a marker of advanced atherosclerosis. It should be underlined that medically treated patients (G1) were older and had lower EF (33.5%), and were more often diabetic, than the revascularised patients (i.e. G2 and G3). With no doubt, this contributed to the decisions made by this subgroup of patients (no consent for CABG or PCI) and promoted selection for conservative treatment among cardiologists and cardiac surgeons.

It should be underlined, that in the years 2000–2002, PCI of the LMS was performed only in selected patients within the study population. In 2001, a 24-hour cathlab duty for patients with ACS was initiated — that is why 71% of ACS patients (including 30% of the patients in cardiogenic shock) underwent PCI of the LMS. The number of PCI of the LMS had increased since 2003 when elective LMS procedures were started.

Our results demonstrate high mortality rates in patients with LMS stenosis. In-hospital mortality in patients treated medically was 7.4%, in CABG patients — 6.4%, whereas in PCI patients mortality rate was as high as 25.4%. It should be underlined, however, that in the last subgroup, 11.9% of deaths occurred during PCI performed in the setting of ACS (including nearly 1/3 of patients with cardiogenic shock). This can be compared with perioperative mortality in CABG subgroup which was as low as 0.7%.

Poor prognosis in patients undergoing PCI for an ACS has been demonstrated by Marso et al. [4] and De Luca et al. [5] — the reported success rate of PCI was 88% and 67%, respectively. In-hospital mortality in these studies was 55% and 58%, respectively. Also in the ULTIMA study, representing, similarly to our study, a real life setting, in-hospital mortality in PCI patients was relatively high, amounting to 13.7%. However, the in-hospital death rate in CABG patients was higher than reported in the CASS study — 4.6% [7], and in Cleveland Clinic study — 2.3% [8]. During the post-discharge period, mortality rates in the revascularised patients were substantially lower compared to in-hospital figures. As it was shown in previous studies [7–10], our study also demonstrated the highest mortality in non-revascularised patients with LMS stenosis. In G1, one-year mortality was 14.3%, and 5-year mortality — 31.4%. It is worth emphasising, however, that these rates were lower than in other studies mentioned above, which had been carried out back in the eighties. This can be related to the improvement in medical therapy and to revascularisation procedures (CABG and TVR) carried out during follow-up. Undoubtedly, this is also the result of significant lifestyle modification including diet, exercise and smoking cessation). These data were confirmed by the COURAGE study [11], that underlined the role of optimal pharmacotherapy, which needs to be implemented prior to the decision concerning PCI in patients with stable angina. It should be kept in mind that most recent ACC/AHA/ESC guidelines on stable coronary artery disease recommend postponement of intervention even in case of advanced multi-vessel disease providing that intensive and multilevel conservative treatment is implemented [12].

At one year, lower mortality was noted in our CABG group (G2), than in the Cleveland Clinic study (11%) [8]. However, as compared to 5-year results of the CASS study, with mortality rate of 15%, in our study it was higher and reached 24.5%.

In G3 patients (treated with PCI in LMS) there were no deaths at one year (in-hospital period excluded). It was only in the 2nd year of follow-up that 1 (1.5%) patient died. In other studies published to date, mortality rates were not that low. In the study by Silvestri et al. [13], mortality rate at one year was 8%, and in the group described by Park et al. [14], two-year death rate was 3.2%, three-year death rate [15] — 7.4%, and in the study by Takagi et al. [16] mortality was 11.9%. The low long-term mortality in PCI patients in the present study can be explained by the fact that the patients were younger and had less advanced coronary atherosclerosis when compared with the other groups. Moreover, in the majority of G3 patients, the intervention in the LMS was performed in the setting of ACS, and single-vessel disease was more common in this group. Thus, after the culprit lesion destabilisation was managed, these patients rapidly improved. Additionally, the fact that they were subjected to extensive follow-up (exercise test after 6 weeks, coronary angiography at 3–6 months) resulted in faster diagnosis of restenosis and prompt intensified management in patients with symptom progression.

When analysing our data of the subgroup with more advanced coronary atherosclerosis and LMS stenosis, the results of other studies concerning multi-vessel coronary artery disease should be brought to attention, such as ARTS I and MASS-II [17, 18] In the MASS-II study, after one-year observation, signi-

ficantly lower death rates were demonstrated in the groups analogous to our study (1.5% *vs* 4.0% *vs* 4.5%, respectively) [18]. Importantly, 5-year mortality in ARTS I study in CABG patients was lower, and in patients after multi-vessel PCI — comparable to our results (8.8% and 30.3%, respectively).

Unfortunately, none of the methods used in LMS treatment is perfect. When CABG is considered, atherosclerosis progression of the native vessels and the grafts must be taken into account. When PCI is considered, notwithstanding the great advance in interventional cardiology (including drug eluting stents, intravascular ultrasound for optimising procedural outcome and advanced pharmacotherapy), two serious complications should be kept in mind, i.e. restenosis and in-stent thrombosis. The second of these drawbacks was not recorded in our study. It should be underlined, however, that our study population, only bare metal stents were implanted, in which in-stent thrombosis rate is low.

Restenosis in the revascularised LMS was found in 11.9% of patients during the first 8 months after PCI procedure. In this subgroup, repeat PCI was performed. Somewhat higher restenosis rates were reported by Park et al. [14] — 21.1% and Silvestri et al. [13] — 23%. Repeated PCI rate similar to our results was reported by Dudek et al. [19] and Silvestri et al. [13] — 9.4% and 10.5%, respectively. It should be underlined, however, that this result refers to low risk patients. Conversely, in high risk group Silvestri et al. [13] reported the need for repeat PCI of the LMS in 21% of the patients. Similarly in the ULTIMA study [6], in which chiefly patients who were disqualified from CABG were included, a high rate of TLR was demonstrated (24.2%).

During the long-term follow-up of patients treated by PCI no significant progression of LMS atherosclerosis was found. In the population studied, only one (1.5%) patient needed repeat angioplasty of the LMS in the 3rd year of follow-up. This was due to *de novo* lesion distal to the implanted stent.

Progression of LMS disease was also found in patients treated by CABG. The reasons for percutaneous revascularisation in this group were progression of atherosclerosis and graft failure. As early as in the first year, PCI of the LMS was warranted in 9.95% of the patients. Chieffo et al. [20] demonstrated lower rate (3.6%) of PCI in the protected LMS during the first-year of follow-up. However, these were low risk patients (average Euroscore 4.3 ± 3.4). Also in a study by Palmerini et al. [21], repeated-PCI rate was lower in 430-day follow-up (2.6%).

In the majority of medically treated patients no significant progression of the LMS stenosis was noted (mean LMS stenosis did not exceed 65%). It is worth mentioning that no PCI of the LMS was performed in this group. These patients consistently kept declining such procedure throughout the entire follow-up period. At the same time, however, 12% of these patients consented to CABG operation, and in 38.1% of the patients PCI of one of the major coronary arteries was performed. Taking into account that the majority had subsequent coronary angiography and that first qualification for the procedure was undertaken in the years 2000–2003, it can be assumed that the lack of consent resulted from medical advice that these patients had been receiving at that time, concerning poor prognosis and high risk level of the intervention. Hence, in patients with stable LMS stenosis in the control angiography, revascularisation procedure was not strongly advocated.

Undoubtedly, atherosclerosis is a continuous and diffuse process, so apart from treatment for LMS stenosis, there was a need for revascularisation of major epicardial arteries (CABG or PCI) in the majority of patients. Some of these procedures were planned during index hospitalisation, when the diagnosis of the LMS disease was originally made. However, the unplanned PCI was carried out more often in patients with non-revascularised LMS (54.2%), than in post-CABG patients (50%) or in patients after PCI of the LMS (14.9%). A non-significantly higher rates of TVR were reported by Takagi et al. [16] and Chieffo et al. [20] (16.4% and 19.6%, respectively). Conversely, in the studies by Valgimigli et al. [22] and Dudek et al. [19] or in the MASS-II study [18] these rates were lower (10%, 7.8%, 13.3%, respectively). Most surprising, however, was the comparison of TVR procedures in patients who had previously undergone surgery. In the MASS-II study [18], one-year PCI rate in post-CABG patients was as low as 0.5% [18] and in the ERACI II study — 4.4% [23]. During 6-month follow-up, Chieffo et al. [24] demonstrated the need for PCI in 3.6% of the patients. In our study, yearly rate of such procedures was over 8 times higher and nearly 14 times higher at five years. Importantly, in 9% of these patients several TVR procedures were required.

In 4.5% of PCI patients, CABG was performed within 30 days of the initial PCI procedure for LMS disease. Surgical treatment, however, was a continuation of the revascularisation initiated as a result of an acute coronary syndrome. During the subsequent 11 months, no CABG procedures were carried out in this group. During the following two years, CABG was carried out in 3 (4.5%) patients. In the study by Takagi et al. [16], the surgical revascularisation rate at one year was somewhat lower (7.5%). On the other hand, CABG rates reported by Silvestri et al. [13] and by ULTIMA Investigators [6], were slightly higher 10.43% and 9.4%, respectively). Interestingly, CABG rates reported in these two studies are not significantly different from CABG rates in G1 (12.2%) and G2 (10.28%) of our study population, and this holds true for the entire follow-up period. However, it should be emphasised that one-year TVR-CABG rate in our population is higher than among MASS-II patients with multi-vessel disease (6.0% *vs* 0 *vs* 3.5%, respectively) [18].

Despite pharmacotherapy and repeat revascularisation procedures (PCI or CABG), recurrent MI could not be prevented in some patients. Albeit recorded in all three groups, recurrent MI was with no doubt most frequent in the CABG group (45.1%) followed by the group that was managed me-

dically (40.8%). The MI incidence in this group was probably related to the extent of atherosclerosis and risk factor profile. Myocardial infarction was least frequent in PCI patients (G3; 22.2%). The analysis of MI incidence by follow-up period showed that MI was most frequent within a year of the diagnosis. In this particular period, MI incidence was the highest in G1 (24.7%) and the lowest in G3 (7.5%). This figure is not significantly different from the one reported in the ULTIMA study (9.8%) [6]. On the other hand, when compared to the results of Valgimigli et al. [22] (MI in 4% of the patients over 16 month-follow-up) or Takagi et al. [16] (MI in 3% of the patients over 3 year follow-up) or in the ERACI II study [23] where MI was found in 2.7% of the population, these rates in our study are clearly higher. Also, MI incidence in CABG patients significantly exceeds the numbers reported by Chieffo et al. [20] (1.4%) and the ERACI II study (6.2%).

Keeping in mind these 'historical' studies, most recent prospective real life trials such as the SYNTAX trial (Synergy between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery) [25] and Polish LE MANS study (Unprotected Left Main Stenting versus Bypass Surgery) [26] should be brought into attention. In the SYNTAX trial population, in 38.8% of post-CABG patients and in 39.5% of post-PCI patients, LMS stenosis was diagnosed. In this subpopulation, total MACE rate did not differ between post-PCI and post-CABG patients (13.7% and 15.8%, respectively, p = 0.44). However, when particular MACE rates in the SYNTAX population are analysed, it becomes evident that repeat revascularisation was more frequently needed in the post-PCI than in post-CABG patients (11.8% *vs* 6.5%, p = 0.02). Conversely, stroke incidence was higher in the post-CABG patients in comparison to the post-PCI patients (2.7% *vs* 0.3%, p = 0.01). It should be underlined that repeat intervention in patients with advanced coronary atherosclerosis and such 'technically complex' lesions was lower than in previous studies. Moreover, the need for repeat revascularisation did not influence mortality rates and MI incidence. In another study by Buszman et al. [26], LMS stenosis was diagnosed in all patients. One-year survival was not significantly different irrespective of the revascularisation method used (PCI — 98.1% *vs* CABG — 92.5%, p = 0.32). Also, the total MACE rate was comparable in subgroups treated by PCI and CABG — and this holds true for the first year after the procedure (71.2% *vs* 75.5% respectively, p = 0.29), as well as for the subsequent years (53.9% *vs* 56.6% respectively, p = 0.47).

Similarly to the SYNTAX study, the need for repeat revascularisation was more frequent after PCI than after CABG (28.8% *vs* 9.4%). Unfortunately, SYNTAX and LE MANS results cannot be directly compared with our results, as the revascularised patients included in our study were more diversified in clinical terms (ACS, cardiogenic shock, some of these patients were not eligible for both methods of revascularisation, etc). However, 5 year follow-up results of our population are similar to the SYNTAX results at one year.

CONCLUSIONS

1. Survival analysis of the patients with significant LMS stenosis revealed the highest mortality when conservative treatment is used. No significant mortality difference was noted in the revascularised patients, irrespective of the revascularisation method applied.
2. The highest recurrent cardiovascular adverse event rate was found in conservatively treated patients.
3. During 5-year follow-up, the need for repeat revascularisation was significantly more frequent in patients in whom the LMS was not initially revascularised.
4. Analysis of long-term treatment outcomes in patients with significant LMS stenosis showed that both PCI and CABG should be treated as complementary methods.

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Analiza porównawcza wyników leczenia zachowawczego oraz rewaskularyzacji przezskórnej i chirurgicznej u pacjentów z istotnie zwężonym pniem głównym lewej tętnicy wieńcowej na podstawie 5-letniej obserwacji

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Streszczenie

Wstęp: Istotne zwężenie w pniu głównym lewej tętnicy wieńcowej (LMS) wiąże się ze znacznie gorszym rokowaniem pacjenta. Jeszcze do niedawna terapia zwężenia w tym odcinku drzewa wieńcowego była zarezerwowana dla kardiochirurgów. W niniejszej pracy oceniono rokowanie długoterminowe u chorych z istotnym zwężeniem w LMS w zależności od metody leczenia: farmakologiczne, kardiochirurgiczne (CABG) i przezskórne (PCI).

Metody: Analizowano populację 450 pacjentów z istotnym zwężeniem w LMS (%DS > 50%). Do Gr. 1 włączono 105 pacjentów, niezakwalifikowanych do rewaskularyzacji. Do Gr. 2 zakwalifikowano 282 chorych poddanych CABG. Natomiast u 67 pacjentów z Gr. 3 w obrębie LMS implantowano stent. W Gr. 2 i Gr. 3 oceniano częstość występowania powikłań po zabiegach rewaskularyzacji. Ponadto, w całej populacji analizowano odsetek niekorzystnych zdarzeń sercowych, tj. zgon, ponowny zawał serca i konieczność ponownej rewaskularyzacji podczas hospitalizacji oraz w obserwacji długoterminowej.

Wyniki: Podczas 5-letniej obserwacji największą śmiertelność stwierdzono w Gr. 1 w porównaniu z Gr. 2 i Gr. 3 (odpowiednio 31,3% *v.* 24,5% *v.* 26,8%). Nie wykazano różnicy w częstości zgonów między Gr. 2 i Gr. 3. Ponowny zawał serca najrzadziej występował w Gr. 3 (22,2%) w porównaniu z Gr. 1 (40,8%) i Gr. 2 (45,1%). Nie zanotowano różnicy w częstości ponownej rewaskularyzacji w LMS: PCI (Gr. 2 — 19,85%; Gr. 3 — 13,4%) oraz CABG (Gr. 1 — 12,2%; Gr. 2 — 10,2%; Gr. 3 — 9,0%). W Gr. 1 w porównaniu z Gr. 2 i Gr. 3 najczęściej zachodziła konieczność wykonania TVR (odpowiednio 69,49% *v.* 53,19% *v.* 31,35%).

Wnioski: Analiza badanej populacji z istotnym zwężeniem LMS wykazała, że zarówno CABG, jak i PCI wiążą się z podobnym rokowaniem długoterminowym.

Słowa kluczowe: zwężenie pnia głównego lewej tętnicy wieńcowej, przezskórna rewaskularyzacja, pomostowanie aortalno-wieńcowe

Kardiol Pol 2010; 68, 4: 381–390

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Praca wpłynęła: 14.09.2009 r. **Zaakceptowana do druku:** 02.12.2009 r.